# Curved Microchannel Plates and Collimators for Spaceflight Mass Spectrometers, Phase I

Completed Technology Project (2018 - 2019)

## Project Introduction

This proposal will develop curved microchannel plates (MCPs) and collimators for spaceflight instrumentation. The curvature will improve measurement quality and volume utilization by allowing the detector to conform to the physical geometry of the instrument. For example, an instrument may view the space environment in 360 degrees of azimuth with cylindrical symmetry. In this case, a cylindrical MCP may be used to exploit the instrument housing geometry to simplify either direct particle detection, or detection of secondary electrons that provide timing signals. Where secondary electrons must be detected, the compatibility of the curved MCP with the instrument geometry may be used to shorten electron flight paths, and consequently reduce high voltages needed to steer secondary electrons to their MCP target. Additionally, continuous, curved MCPs can relieve structural mounting complexity and the consequential vibration mode complexity.

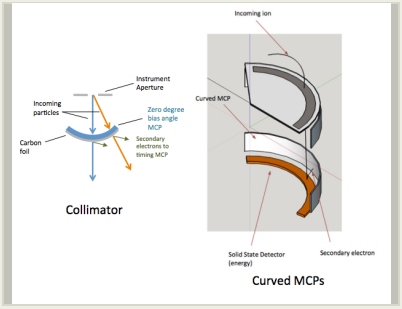
The MCPs will be made by bending glass capillary arrays, then applying thin films to provide the functionality of a microchannel plate electron multiplier. This two-step approach makes possible nearly any shape for an MCP. Another benefit of this approach is that the microchannels will always have the same angle relative to the surface normal at any location. This will make the detection efficiency the same for all particles with normal incidence at any location on the MCP.

A similar approach can be used for simple, lightweight collimators. Microchannels can be oriented perpendicularly to the surface, and the curve made to fit the symmetry of the entrance system. A carbon foil may be added to the surface of the collimator to provide a secondary electron for timing measurements. Although the cylindrical nature of the microchannels introduces some specular reflection from the interior of the channels, this approach offers the benefit of mechanical simplicity and light weight for a collimator application.

## Anticipated Benefits

The curved MCP or collimator may be used in any spaceflight particle detection instrument, to improve volume utilization and measurement quality. These are instrument-enabling benefits for instruments in the CubeSat scale, as well as instruments in mass-constrained deep space missions.

The curved MCP may be used for terrestrial mass spectrometers, cylindrical beam monitors, or MCP-photomultipliers for compact cylindrical geometries, in which flight path uniformity from source to detector is critical for photon timing.

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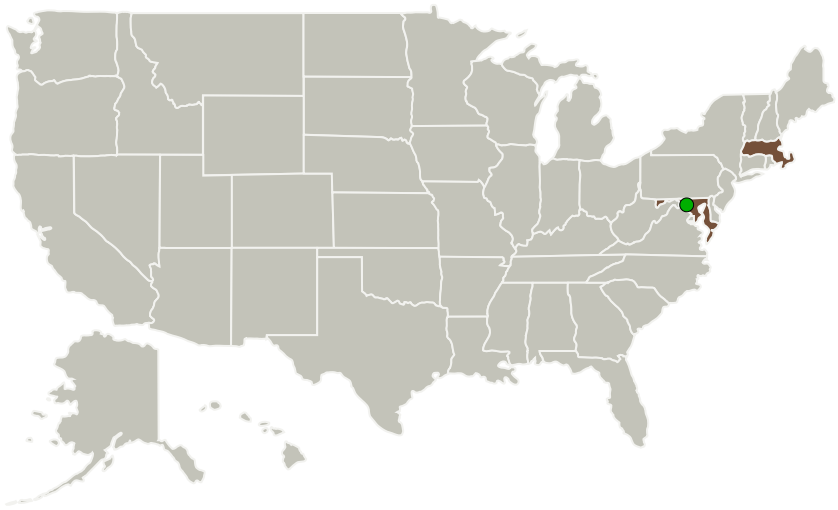
## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Incom, Inc. | Lead Organization | Industry | Charlton, Massachusetts |
| Goddard Space Flight Center(GSFC) | Supporting Organization | NASA Center | Greenbelt, Maryland |

| Primary U.S. Work Locations | |
|---|---|
| Maryland | Massachusetts |

## Project Transitions

**July 2018:** Project Start

**February 2019:** Closed out

**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/140997)*

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Incom, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

Carlos Torrez

**Principal Investigator:**

Mark Popecki

**Co-Investigator:**

Mark A Popecki

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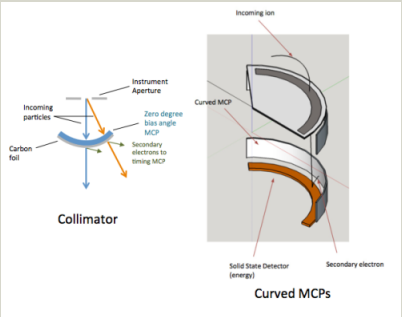
## Images

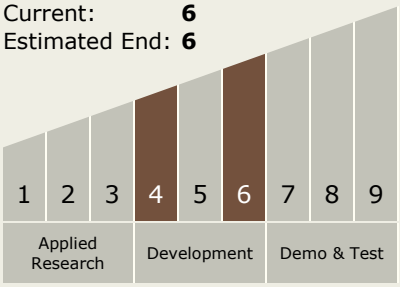



**Briefing Chart Image**
Curved Microchannel Plates and Collimators for Spaceflight Mass Spectrometers, Phase I
*(https://techport.nasa.gov/image/135058)*

**Final Summary Chart Image**
Curved Microchannel Plates and Collimators for Spaceflight Mass Spectrometers, Phase I
*(https://techport.nasa.gov/image/133737)*

## Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**




## Technology Areas

**Primary:**

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.1 Field and Particle Detectors

## Target Destinations

The Moon, Mars, Others Inside the Solar System